

## **Notice of Interest DE-AR52-09NA29249**

February 18, 2009

This Notice of Interest concerning the release of a Broad Agency Announcement (BAA) to solicit research and development (R&D) regarding Nuclear Explosion Monitoring Research and Development (NEM R&D) is issued in accordance with 10 CFR Part 600 and 48 CFR Part 35.016. Offerors should not submit a proposal in response to this Notice of Interest, but may submit a proposal after release of the solicitation.

The United States Air Force Research Laboratory (AFRL) and the Department of Energy's National Nuclear Security Administration (NNSA) are strong advocates for the small business community and interested small businesses, small business-lead teams, and joint ventures that qualify as small businesses are especially encouraged to submit proposals under this BAA.

**Description:** AFRL and NNSA will jointly solicit proposals for R&D to improve national capabilities to detect, locate, and identify nuclear explosions. It is anticipated that this planned solicitation will be released on or about March 18, 2009 and close on or about May 7, 2009 seeking proposals with a period of performance of 1-3 years with awards starting in fiscal year (FY) 2010. Research products developed under this planned solicitation shall support Air Force requirements for improving the nuclear explosion monitoring capabilities.

The objective of this planned solicitation is to enhance U.S. capabilities in nuclear explosion monitoring primarily with ground-based systems. This will be achieved through advances in the state-of-the-art for nuclear explosion monitoring, basic and applied research that enhances understanding of the underlying phenomena, developing new methods of tackling monitoring problems, or developing new data for use in nuclear explosion monitoring. Field experiments may be proposed.

Individual proposals should be directed to only one of the topic sub-areas described below, but the Offeror may submit proposals in more than one topic sub-area. All topic sub-areas are of importance. However, depending on the proposals received and programmatic needs, funding may not be distributed evenly among the topic sub-areas.

Research is being sought in the following topic areas:

**TOPIC 1: Radionuclide Studies**

**TOPIC 2: Regional Seismic Studies**

**TOPIC 3: Seismic Phenomenology**

**TOPIC 4: Seismic Methods in 3-D**

**TOPIC 5: Infrasound Studies**

**TOPIC 6: Hydroacoustic Studies**

## **Topic 1: Radionuclide Studies**

**1a. Xenon Measuring Instrument.** Proposals are sought for the development of compact instrumentation for the quantification of stable xenon as part of a radioactive xenon monitoring instrument with the objective of determining the total amount of stable xenon in a mixed gaseous sample (xenon in nitrogen) from independent measures of pressure, temperature and mole fraction of xenon in order to calculate the stable volume (standard cc's). This measurement is challenging due to the low pressures (1-100 torr) expected during the quantification, placing constraints on the binary gas analysis technique therefore it is expected that new gas sensing technologies will be developed under this project.

The combined relative uncertainty (random and systematic) in the reported volume should be less than 1%. The technology should be robust, field deployable and not require regular calibration (6 months between calibration checks). The anticipated quantity of xenon available for the measurement is 0.25 cm<sup>3</sup> (standard temperature and pressure). The amount of nitrogen is anticipated to be in the range of 0.25 – 0.75 cm<sup>3</sup> (STP). A desired outcome from this work would be a compact instrument or technique usable for both laboratory and automated and unattended field measurements.

**1b. Elimination of Radioxenon Memory Effect.** Proposals are sought for the development of detectors, materials and/or components that can be used for beta-gamma coincident spectrometry gas cells, such as used in the Automated Radioxenon Sampler-Analyzer (ARSA), that exhibits very low or no appreciable memory effect for radioxenon samples in contact with the detector surfaces for >24 hrs. A useful detection system will be rugged enough for field use, and be possible to obtain in quantity. The materials used in a beta-gamma gas cell should allow high detection efficiency at low energy (~30 keV) x-rays and betas up to 1 MeV, and also allow for high resolution (<15% desired) detection of conversion electrons in the range of 100-200 keV.

**1c. Portable Xenon Calibration Sources.** Proposals are sought for portable equipment that can be used to produce low activity level, calibrated radioactive gaseous xenon calibration sources. These sources should be compatible with commercial low level radioactive xenon detection systems and therefore concentrations in the range of 1-10 Bq per sample of radioactive xenon is the desired range. This research must also address a technique to verify that the calibrated xenon sources are reproducible to significantly better than 10% accuracy. Successful proposals will address the production of isotopes such as <sup>133m</sup>Xe and <sup>135</sup>Xe, as well as the more common <sup>133</sup>Xe. Production of these xenon isotopes singly and in combinations are desired, while minimizing the contamination of <sup>133</sup>Xe and <sup>131m</sup>Xe in the samples.

**1d. Xenon Sources and Background.** Proposals are sought for the study of source terms for Xe producing natural, medical, industrial, military and nuclear processes, the fate and transport of the Xe released and the regional backgrounds that might be encountered.

## **Topic 2: Regional Seismic Studies**

**2a. Velocity Models.** Proposals are sought that develop advanced models of the Earth's velocity structure with predictive capability, especially in aseismic regions and in Eurasia. Of particular interest are: new techniques of determining 3-D, spatially variable velocity models; techniques for building models by fitting multiple datasets, especially of different types of data; techniques to estimate the uncertainty in geophysical models and assess the tradeoffs between different parameters of the models, as well as the uncertainty in predicted observables, such as travel times; studies that compare different methods to show their strengths and weaknesses; and models that can predict seismic amplitudes as well as travel times. Consideration should be given to issues relating to integration of models into operational use, such as supplying metadata, including the data used to derive and test the model, how the model is represented, resolution and reliability at the boundary of the model. Priority will be given to studies of Eurasia. The influence of laterally-varying 2-D, 2.5-D, and 3-D structures, including 3-D scattering, on the stability of propagation of Pn, Pg, Sn, and Lg phases and how these phases propagate to local (less than 200 km) and regional distances (less than 2,000 km) are of interest.

**2b. Attenuation Models.** Proposals are sought to develop local and regional attenuation models, with emphasis on their ability to match observed amplitudes of Pn, Pg, Sn, and Lg phases, their codas, and surface waves. Proposals to develop new methods for measuring attenuation, to estimate uncertainty in attenuation models, and to develop models that fit multiple datasets (e.g. body wave and surface wave amplitudes), are of interest.

**2c. Location and Discrimination Ground Truth.** For seismic location calibration, collection of ground truth at a GT5 level (absolute location and depth errors less than 5 kilometers) or better, including dedicated explosions, is sought for events of magnitude 2.5 and larger. Research on new methods of acquiring location ground truth will be accepted under this topic. Studies that generate new discrimination ground truth events, along with source geometry and other characterizing information, are sought. Waveform data, both the data used to define ground truth and any other data generated by the event, are desired. Calibration of regional coda magnitude is of interest.

## **Topic 3: Seismic Phenomenology**

**3a. Seismic Energy Generation.** Proposals are sought that complement existing efforts to understand how seismic energy is generated from a range of sources (explosions, earthquakes, mine collapses, and other modes of rock failure), and how energy is partitioned between P, S, and surface waves. Experiments to improve physical understanding of the generation and initial propagation of these wave types are of interest. Improved explosion source models, both empirical and theoretical, which can predict observed P, S, and surface wave amplitudes over a wide range of frequencies are sought. New methods of estimating the yield of fully coupled explosions, how emplacement conditions affect the observations, and the effect of multiple simultaneous and near-simultaneous explosions, are of interest. Proposals for theoretical and observational investigations will be accepted under this topic.

**3b. Local and Regional Monitoring and Discrimination.** Proposals are sought that would produce new understanding of the properties of small seismic events and their seismic waveforms at local (200 km or less) and regional (2000 km or less) distances. Innovative methods of event detection that are appropriate for local events are of interest. Of particular interest are methods for estimating yield, with low uncertainty, of seismic events recorded at local distances. New methods for discriminating explosions from earthquakes that have a firm

physical and statistical basis are of interest. Methods that can discriminate distributed from single-point explosions are also of interest.

#### **Topic 4: Seismic Methods in 3-D**

Methods appropriate for use in 3-D models, including the determination of such models, are sought. Methods to calculate travel times that are accurate (within 0.01 sec), rapid, and complete (all phases without ambiguity), or any combination of these, are sought; however, accuracy should be at least 0.1 sec. Proposals that examine such questions as what resolution is needed or optimal to obtain a desired accuracy in path travel times or attenuation, and/or what the accuracy that can be expected from a given model, will be considered under this topic. Rapid and accurate methods to compute synthetic seismograms in 3-D media that offer significant advantages over current methods, particularly at high ( $> 1$  Hz) frequencies are desired. Improved techniques for event location in 3-D using models and/or ground truth are sought at local, regional or near-telesismic distances, particularly methods that use more than a single type of data jointly. Robust estimation of uncertainty is of importance.

#### **Topic 5: Infrasound Studies**

**5a. Seismo-Acoustics.** Proposals are sought on the interpretation of signals from co-located infrasound and seismic sensors at local and regional distances. Improved understanding of the fundamental physics of generation of infrasound from underground and near-surface explosions and other sources is desired. The maximum infrasound signal expected from events that do not have a surface component of energy release, such as shallow earthquakes, and the nature of such a signal (impulsive or emergent) are of interest. Proposals that examine scaling of peak frequency and/or amplitude with (effective) source yield at local or regional distances are sought. Experimental, observational and theoretical studies are of interest.

**5b. Propagation.** Propagation of infrasound signals to local and near-regional distances (less than 1,000 km) is of interest, particularly the phenomenology governing reception and characteristics of infrasound signals within the so-called zone of silence. Atmospheric conditions that affect detection, phase association, yield estimation, and event identification are of particular interest. Another topic of interest is the uncertainty in azimuth and range determinations for infrasound signals from seismic events at local and regional distances.

#### **TOPIC 6: Hydroacoustic Studies**

We do not anticipate funding proposals for hydroacoustic studies, however, proposals which would significantly enhance nuclear explosion monitoring through hydroacoustics or which present a unique opportunity in hydroacoustic studies may be submitted for review.

\*\*\*\*\*END OF TOPICS\*\*\*\*\*

AFRL and NNSA reserve the right to determine which procurement instrument shall be used. The procurement instrument shall be appropriate to the scope of work and procuring organization. NNSA will predominantly issue contracts, but financial assistance awards may be used under certain circumstances. The Air Force will issue contracts only. In the event a contract is issued, acquisition regulations apply per 48 CFR, and a cost reimbursement type contract is anticipated. In the event a financial assistance instrument is issued, 10 CFR 600 applies, a cooperative agreement is anticipated.



The BAA will solicit proposals from all responsible organizations (foreign and domestic) including industry, academic institutions, research institutions, and non-profit organizations. Federal agencies may submit proposals as prime/lead contractors subject to appropriations language but may not partner with Federally Funded Research and Development Centers (FFRDC). FFRDCs, including NNSA national laboratories, cannot directly respond to this solicitation as prime/lead participants. FFRDCs, including NNSA national laboratories, may participate in this solicitation as team members; however, such participation must be consistent with the FFRDCs sponsoring agreement. The FFRDC effort for any proposal, in aggregate, shall not exceed 50% of the total effort of the project. Information will be provided in the solicitation on how to include FFRDCs, such as NNSA national laboratories, as a team member(s).

Enhancing programmatic value is encouraged. Low-cost proposals focused on validation or proof-of-principle issues will enhance programmatic value. Teaming is, also, an interesting way to add value, for example, teaming to facilitate integration of research products into the Knowledge Base will enhance programmatic value. Teaming which results in the training of graduate students (in particular university/industry teams working on real world problems with Ph.D. candidates) will enhance programmatic value. Programmatic value is anticipated to be one of the selection criteria for proposals. If teaming arrangements are proposed, a clear statement of the intended benefit of teaming must be provided along with the proposed technical approach, deliverables and costs clearly delineated for individual team members. The Government reserves the right to award to the team or to individual team members.

All awards will have an NNSA Product Integrator (subject matter expert) assigned at the time of award to help ensure the successful transitioning of research products to operations, as appropriate. Information about the NNSA Nuclear Explosion Monitoring Research and Development (NEM R&D) program integration of research products into operational form for the Air Force can be found online at <https://na22.nnsa.doe.gov/KnowledgeBase>.

The NNSA and AFRL each reserve the right to fund, in whole or in part, any, all or none of the proposals and to award without discussions. This Notice of Interest is being issued in advance of passage of FY 2010 appropriations to provide more time for potential offerors to prepare and to allow awards to be made as early as practicable within FY 2010. The topics in this Notice of Interest represent the maximum set of topics that may appear in the solicitation. The final number of topics and awards, however, are subject to the availability of funds.